Appendix H
Recommended Guidelines for Recovery Hatcheries

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INTRODUCTION

Many coho salmon runs in California have experienced local extinction, fragmentation, and brood-year extinction, or are at such low apparent abundance that they are judged at high risk of extinction (Bryant 1994, Weitkamp et al. 1996, CDFG 2002, NOAA Fisheries 2003). Ideally, natural recolonization or supplementation by similar nearby stocks is preferable to using hatchery stocks to recover these runs (Reisenbichler et al. 2003). However, extremely depleted stocks and ESA and CESA listings of many California salmon populations have made it necessary for the Department to evaluate the use of specialized anadromous fish hatchery programs along with extensive monitoring to help meet certain recovery goals. In some of these extreme cases the risks posed by releasing relatively small numbers of hatchery fish from well defined programs focused on recovery are acceptable. Still, the Department considers captive broodstock and recovery supplementation projects to be unproven last-chance efforts to protect and recover severely reduced and imperiled populations. The small number of projects that exist have not shown conclusively that they are able to rehabilitate depleted runs or establish recolonized runs. The evidence of whether hatchery fish can reliably establish natural runs is mixed and the results of hatchery introductions are unpredictable (see review in CDFG 2002). Therefore, it is prudent that recovery hatcheries only be employed when all other means of coho salmon recovery have been exhausted or when extirpation is imminent. The Department does not consider recovery hatchery programs a substitute for habitat improvement and improvement of natural salmon production.

The following definitions of hatcheries are used in this section (also see Attachment 1: Glossary). These are the same definitions used in the status review of coho salmon North of San Francisco in CDFG (2002). There may be some confusion over what is intended by some terms; for example, the term "supplementation" for some people may equate to what we call "enhancement" in this section. This section deals only with recovery hatcheries (translocation of adults to spawn in another place, or of naturally produced juveniles, while they may be considered at some time, are not considered in this document[1]). Modification of existing hatcheries to include a conservation ethic will be discussed in a separate section. Note that success criteria for each of the following are different.

- *Supplementation hatcheries* are intended to contribute to the natural spawning population (primary success criterion is recruitment to spawner population).
- *Mitigation hatcheries* are intended to make up for reductions in natural spawning due to human-caused habitat loss (e.g. dam construction; primary success criterion is replacement of lost production).
- *Enhancement hatcheries* are intended to improve a fishery by increasing the number of catchable fish in the ocean or stream (primary success criterion is recruitment to a fishery).

[1] Natural colonization/supplementation, when feasible, should have priority over hatchery intervention. Recovery hatcheries should only be employed in extreme cases. Translocation of young-of-the-year coho salmon to a watershed where coho salmon have experienced extinction should be explored prior to establishment of a recovery hatchery.

- *Recovery hatcheries* are experimental programs intended to supplement depressed natural populations or provide fish for artificial recolonization of streams that have experienced local or brood-year extinctions, to maintain genetic diversity within and among stocks, and to conserve valuable or rare genes and genotypes. They may, or may not, rely on captive broodstock to accomplish these goals. Recovery hatcheries attempt to minimize or eliminate negative effects common to fish culture, resulting in as close to wild fish as possible (primary success criteria are increased abundance of spawners and/or outmigrants, lowered risk of extinction, recolonization of a self-sustaining population, and/or brood-year reconstruction, while avoiding negative hatchery impacts as much as possible).

California has only five current coho salmon artificial propagation programs (Table H-1). Two of these, Big Creek Hatchery and Don Clausen/Warm Springs Hatchery are currently operated as recovery hatchery programs for coho salmon. Only two other anadromous salmon recovery hatchery programs exist in California; both produce winter-run Chinook salmon. The USFWS operates a recovery supplementation program and, in cooperation with U.C. Davis' Bodega Marine Laboratory,[2] a captive broodstock program for winter-run Chinook salmon at Livingston Stone National Fish Hatchery located at the base of Shasta Dam on the Sacramento River. Trinity River and Iron Gate Hatcheries are mitigation facilities. Noyo Egg Taking Facility and, to a much lesser extent Big Creek Hatchery, are intended to provide fishery enhancement.

RECOMMENDATIONS FOR DEPARTMENT POLICY ON RECOVERY HATCHERIES FOR COHO SALMON

The Hatchery Working Group of the CRT and reviewers in the Department (Attachment 2) developed the following recommendations for policies that concern the establishment, operation, and closure of recovery hatcheries for coho salmon. The recommendations were developed using the best available scientific information, and are consistent with the Fish and Game Code sections relevant to hatcheries for anadromous salmonids (Attachment 3), the California Endangered Species Act (CESA), and Fish and Game Commission (Commission) and Department anadromous fish policies (Attachment 4). Although these policy recommendations are specific to coho salmon recovery, they apply equally well to any recovery hatchery for recovery of anadromous salmonids, and we recommend that they be used as guidance for any recovery hatchery.

The following policies should be applied to all coho salmon recovery hatcheries.

1. The purpose of a recovery hatchery as defined in this section is to aid and/or accelerate recovery of coho salmon by reducing risk of extinction due to one or more of a number of factors that result from low abundance, cohort failure, and/or drastic population fluctuation. The focus of a recovery hatchery is to reduce extinction risk and improve natural production in accordance with Department, Commission, and Federal Endangered Species Act (ESA) policies.
2. The Department considers recovery hatchery programs for the purpose of restoring natural runs of salmon to be unproven. The number of facilities

[2] Originally this project was done in cooperation with both U.C. Davis' Bodega Marine Laboratory in Bodega Bay, and Steinhart Aquarium in San Francisco. However, cooperative elements at Steinhart Aquarium have recently been phased out of the program.

should be limited to that which is necessary to meet identified coho salmon recovery needs. The number of facilities should be sufficient to meet recovery needs, but small enough to ensure that agencies can effectively coordinate recovery at the ESU and range-wide level, maintain connectivity and communication among programs, resource agencies, and the public, promote efficient use of resources, and avoid overproduction of hatchery-origin coho salmon. The number of facilities should be scaled to avoid redundancy and to ensure that recovery is not disproportionately reliant on hatchery-origin coho salmon.

3. In accordance with items 1 and 2 above, recovery hatchery operations will avoid excess hatchery production above that which is deemed necessary by the Department and NOAA Fisheries to meet recovery goals. The number of fish produced should be sufficient to significantly reduce the probability of extinction, accurately represent the genetic variation in the natural population, minimize random or directional genetic change in captivity, and to re-establish a self-sustaining natural run.
4. In all cases, recovery hatchery operations should be subsequent to or concomitant with active and focused habitat improvements designed to increase natural production with the ultimate objective of reaching recovery goals.
5. All recovery hatchery programs must be part of and integral to the overall plan for recovery of coho salmon at the ESU and range-wide levels.
6. All recovery hatchery programs must be consistent with CESA and ESA.
7. Recovery hatchery programs should have a planned, finite, and short-term lifespan. Ideally the life of a recovery hatchery program would be only 1-3 generations. However, the Department recognizes that unique elements of coho salmon life-history may necessitate longer-term projects on the order of 3-4 generations to accomplish difficult tasks like rebuilding missing year classes or repopulating locally extinct runs. In such cases, the life-span of the recovery hatchery should be the minimum amount of time consistent with reaching specific project goals.
8. All operations should be continually assessed and modified to avoid establishment of a hatchery-dependent run in which the hatchery persistently acts as the source in a source-sink relationship with the natural run; A comprehensive risk/benefit analysis will be prepared prior to the establishment of any new recovery hatchery operation.
9. Recovery hatcheries must be operated in a way that protects naturally recovering coho salmon populations from the possible adverse biological and monitoring effects of inadvertent hatchery influence, especially those populations specifically targeted for natural recovery and nearby populations that are not targets of hatchery-based recovery efforts.
10. Recovery hatchery operations should be done in a way that protects all existing populations of native salmonids and other native fish already living in the receiving ecosystem. An assessment (e.g., identification of species composition, size, and density measurement) should be done to determine if there will be impacts (e.g., competition, predation, niche partitioning) to fish already present.
11. Hatchery releases should be based on the receiving ecosystem's carrying capacity. Conservation/recovery hatchery programs should only be approved in

places where guideline conditions are met and habitat is not a limiting factor for the existing natural stock, where unused habitat is demonstrably available, and where competition and other negative ecological interactions between natural- and proposed hatchery-origin stock can be avoided or are minimal. Habitat availability includes demonstrably consistent connectivity of spawning habitat, rearing habitat, and corridors for migration under current conditions. In special cases, exceptions may be made for places where necessary habitat improvements are obvious, relatively easy to do in a short time, and have a high probability of substantially improving a stream's ability to support coho salmon. In these cases, recovery hatchery construction may be conditionally approved with the condition that substantial progress is made toward habitat improvement prior to releasing fish. Requiring suitable habitat increases the probability of success of supplementing natural runs and will avoid creating unwanted hatchery-dependent runs.

12. Recovery hatchery programs should be located to maximize recolonization potential of nearby depleted streams through natural metapopulation processes, while attempting to avoid circumventing natural patterns of reproductive isolation among populations.

13. Existing facilities should be used for recovery actions before constructing new ones for efficiency and to concentrate scarce resources. However, the Department recognizes that in many cases existing production facilities that were designed for a very different purpose will require substantial modification to meet recovery hatchery needs.

14. When considering the establishment of new facilities, coordinated efforts that are consistent with, and integral to, the overall recovery plan and involving active participation of State, Federal, and Tribal resource agencies, watershed groups, or stakeholder groups, will be preferred to isolated projects. Interagency and intergroup coordination is a necessary feature for establishing and operating a recovery hatchery and recovery hatchery program. Development of MOAs among participants for recovery hatchery programs should be required.

15. Guidelines presented in this section will be used by the Department along with any other appropriate information and decision-making processes to determine whether a recovery hatchery program is needed, what general kind of operation it should be, and how to operate, monitor, report, and decommission the facility. Guideline criteria should be evaluated at the population level, not on a stream or watershed basis, to ensure that hatchery operations are consistent with population viability and Federal/State recovery goals.

16. Recovery hatchery programs should have detailed operating plans, including emergency and decommission plans prior to the beginning of operations. Plans should carefully define the intended geographic scope of the project (e.g., run, watershed, region, ESU). These plans should include provisions for adaptive management.

17. Steering committees or technical advisory groups consisting of teams of technical experts and management staff should be be established to advise and assist in the operation of each facility. These committees must include at a minimum representatives of the appropriate Federal, State, and Tribal resource

agencies (including, but not limited to, NOAA Fisheries, CDFG, and, in some cases, USFWS and/or Tribal Fisheries Agencies), permitting agencies, and the permittee. Inclusion of other technical and management personnel to meet specific advisory needs should be included as necessary and appropriate. An independent committee of conservation professionals in specific areas of expertise (e.g., genetics, population viability, ecology) should be established for consultation on highly technical issues. Final decisions concerning hatchery operations are the responsibility of the Federal and State permit holder operating the facility, and will be done in accordance with permit conditions while striving to meet coordinated recovery goals.

18. Research on topics that aid or accelerate recovery is an appropriate secondary use for recovery hatchery programs and their products.
19. The Department will coordinate with NOAA Fisheries on the establishment and operation of recovery hatchery programs.
20. Appropriate Federal and State permitting is required prior to the operation of any recovery hatchery or recovery hatchery program.

GUIDELINES FOR ESTABLISHMENT AND OPERATION OF RECOVERY HATCHERY PROGRAMS

The Working Group developed guidelines for the use of captive broodstock and/or recovery supplementation as an integrated tool for coho salmon recovery. The following research and guidance documents were influential in the development of the guidelines: Hard et al. 1992, CDFG undated, Weitkamp et al. 1996, Busby et al. 1996, Myers et al. 1998, Waples 1994, NMFS 1999, Flagg and Nash 1999, CDFG/NMFS 2001, NMFS 2003, and Reisenbichler et al. 2003. For example, see Attachment 5 for relevant information from Reisenbichler et al. (2003).

Table H-1 contains guidelines for conditions under which some type of recovery hatchery program for coho salmon may be appropriate. The guidelines describe conditions regarding abundance, brood-year cycle, uniqueness relative to other populations, carrying capacity and productivity, potential for natural recolonization, and value. Meeting any of these criteria is suggestive that a recovery hatchery program may be appropriate as a component of a recovery strategy. Using these guidelines along with the policies identified in this section, the Department can decide on which programs will best address coordinated recovery needs.

Figure H-1, which also cites Table H-2, shows a simplified flow chart that can be used in the initial phases of determining whether a recovery hatchery should be contemplated as a recovery tool.

Identification of reproductively isolated populations is essential to maintaining existing patterns of diversity in coho salmon. The Department should use any and all information on patterns of reproductive isolation to identify populations including results arrived at through NOAA Fisheries Recovery planning process, population genetics data currently in development, geographic data, ocean distribution data, mark data, phenotypic data (e.g., run timing, age structure, outmigration timing, size and growth), and any other data deemed appropriate.

Establishment of a recovery hatchery should require that a coho salmon population be a component of an ESU listed as endangered, or that it meet the strict guidelines presented in this section. Recovery hatcheries should be minimally employed, if at all, in the SONCC Coho ESU, but may be more appropriate for use in the CCC Coho ESU.

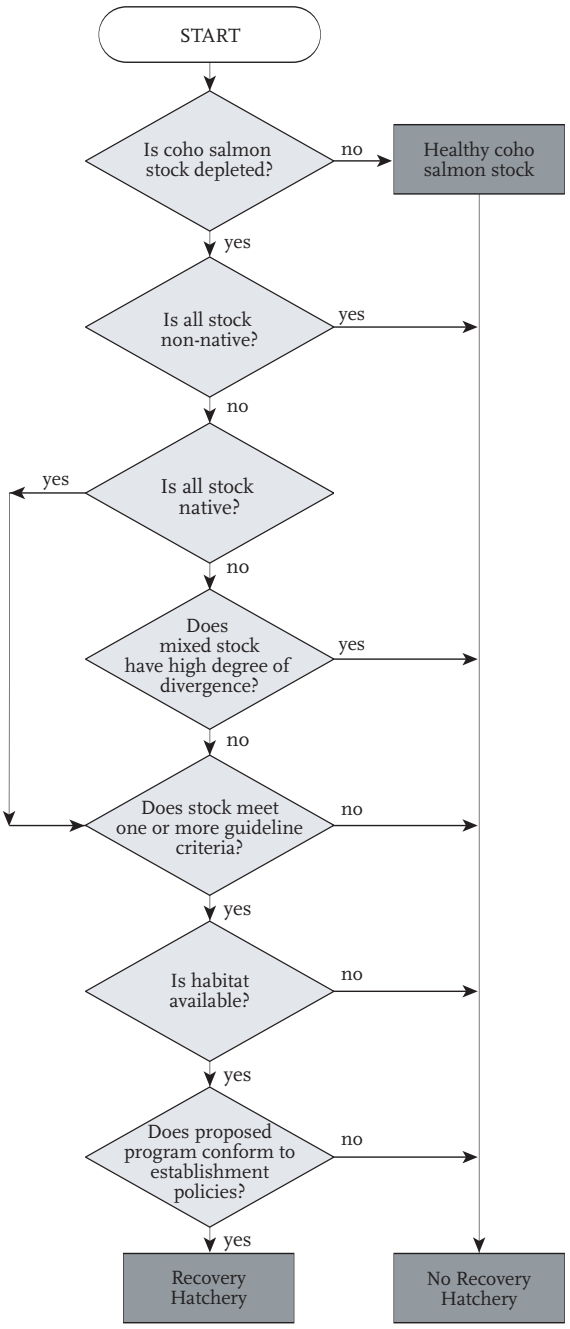
TABLE H-1: Decision guidelines for establishing a recovery hatchery program (after NMFS 1999 with modification)[1]

CATEGORY	GUIDELINES	TYPE OF PROGRAM INDICATED
Abundance [2]	Very low abundance OR Low abundance and declining OR Moderate abundance and precipitous decline OR Low to moderate average abundance and high amplitude of population fluctuation that frequently includes zero OR Little or no natural production over at least one generation (3 years)	CB, RS, G
	Low abundance relative to available habitat and production capacity	CB, RS
Brood-year cycle	Two of three brood years are consistently missing or extremely weak	CB, G
Uniqueness relative to other populations	Evidence of unique genetic qualities and meets one or more or the abundance or brood-year cycle criteria	CB, RS, G
	Unique adaptations to specific local conditions and meets one or more or the abundance or brood-year cycle criteria	CB, RS, G
Carrying capacity and productivity	Population has unrealized potential for high productivity in the currently available habitat in comparison to other populations in the ESU due to consistently lower than supportable population size or chaotic population size fluctuation	RS
Potential for natural recolonization	Historically present but currently extinct, good measured habitat is available AND Potential for natural recolonization is low	CB, G
Value	Unique social, economic, or cultural value, including unique importance to Tribal society, economy, or culture AND meets one or more of the abundance or brood-year cycle criteria	CB, RS, G

NOTES:

1. Meeting any of these criteria indicates that a captive broodstock program (CB), a recovery supplementation project (RS), a cryopreservation project (G), or some combination, as integrated elements of the recovery plan might aid or accelerate recovery. The population must have been judged to be at high risk of extinction in the immediate future as a prerequisite to establishing a captive broodstock program. Application of these guidelines assumes that there is good evidence that habitat is currently available, including viable connections between spawning areas, rearing areas, and the ocean.
2. Based on population size which may include more than one stream or watershed.

FIGURE H-1: Flow chart depicting simplified decision rules for exploring whether a coho salmon recovery hatchery may be an appropriate recovery tool



Refer to Table H-2 for specific guidelines, and to the text for specific establishment policies. (After Flagg and Nash 1999 with modifications.)

TABLE H-2: General guidelines for operation of a recovery hatchery program. Individualized operations plans for each project should be designed in consultation with resource agencies and steering committees and in accordance with permit conditions.

ISSUE	GUIDELINES
Source populations for broodstock	Best guidance is to rely on results of recent population genetic analyses and life history data to find the most similar stock (i.e., a stock with the same ancestral lineage) to the target stock.
	Nearby stocks are the most likely candidates for reintroductions, but genetic analyses should be used to verify their suitability.
	Donor stocks should be from streams that are ecologically similar to the receiving system to increase the likelihood that they are well adapted to it.
	Donor stocks should have similar pattern of within-population genetic diversity to extant populations to ensure a basis for adaptive response to environmental change.
	If target population is very small, consider taking all available representatives of the population into the hatchery. But, only if the risk to the population by bringing it into the hatchery is less than that in the stream with habitat restoration.
	If a portion of the adult run is collected as broodstock, collect them throughout the spawning season in proportion to the natural run.
	If a portion of the juvenile population is collected as broodstock, design the collection protocol to avoid collecting large numbers of closely related individuals, e.g., collect from several locations at several times during the natural outmigration period.
	Also avoid mixed collections consisting of juveniles from more than one population.
	Limit the proportion of hatchery fish contribution to broodstock to ≤10% of total OR
	Avoid hatchery fish contribution to broodstock.
Spawning	Spawn captive broodstock only during the natural spawning season.
	Spawn as many adults as possible using single pair matings or from 2-4 males per female.
	Attempt to equalize family size to maximize effective population size (may be best accomplished during rearing).
	Use cryopreserved sperm as appropriate to create desired effects, but take care to balance with reduced viability especially with small numbers of available eggs.
	Consider induced spawning or photoperiod manipulation to maximize the number of captive broodstock spawners available during the natural spawning season.
	If juveniles are used as a broodstock source, determine relatedness among individuals using genetic analysis prior to spawning and use this information to avoid inbreeding.
	Use genetics data as much as possible to avoid inadvertent hybridization in the hatchery.
	Monitor readiness to spawn using best available technologies (e.g., ultrasound).
	PIT tag broodstock to individually identify them.
Fish rearing	Avoid direct human contact with fish that are to be released to the wild whenever possible, e.g., use automatic feeders instead of feeding by hand.
	Consider multiple rearing locations to spread risk in case of catastrophe.
	Control or eliminate disease outbreaks before they occur, manage if they do. Consider whether inoculations are appropriate standard operating procedure.
	Separate family groups as much as possible during rearing and carefully record the composition of groupings.
	Develop redundant systems to avoid loss of broodstock or their progeny.
	Attempt to mimic natural conditions as much as possible, especially for fish that will be released.
	Water supplies should be free of pathogens and predators.
	Determine whether and how both fresh and salt water should be used in the program, and carefully manage and document transitions of fish from one to the other.
	Attempt to equalize parental contribution to maximize effective population size.

(continued)

TABLE H-2: General guidelines for operation of a recovery hatchery program (continued)

ISSUE	GUIDELINES
Release protocols	Release juvenile fish as early as possible to attempt to avoid domestication. However, this issue may not be easy to resolve because other options may be more attractive for a given program. Considerations should be given to the tradeoffs between return rate, release size, and fitness (see Reisenbichler et al. 2003, Table 4, in Attachment 2 for a review). A combination of life-stage release strategies is also worth considering, although combinations may significantly complicate monitoring.
	Attempt to release juveniles at the same size as the natural fish to improve the chances that the hatchery and natural fish will have similar life histories related to size at outmigration.
	Hatchery capacity and cost may be a factor in life stage at release (i.e., releasing smolts may cost more and use up more space for a longer time than releasing fry).
	Release into stream at the place you want them to return, possibly after an imprinting period if the release location is not in the same place as the rearing location
	Release number should be scaled with carrying capacity to avoid possible increases in density dependent mortality of both natural and hatchery fish when carrying capacity is approached.
	Releasing juveniles in one location may be preferable to scattered releases to exploit the functional response of predators and to assure adequate returns to at least one location. However, scattered releases may be better for stocks that tend to hold in place for a while or residualize.
	Minimize stress associated with handling and transportation.
	Screen all fish for disease before release.
	Transport fish for release in more than one truck, or transport in more than one trip, to spread the risk in case of accident.
	Release protocols should avoid or minimize negative ecological interactions with conspecific natural fish and with other species.
	Develop a monitoring system for hatchery produced juvenile holding, rearing, and outmigration.

The hatchery working group identified two types of recovery hatchery operations for purposes of this Recovery Strategy: recovery supplementation and captive broodstock. These are best thought of as hatchery program components that can be used together or separately depending on the situation and goals of the recovery project. Recovery supplementation would typically involve spawning returning adults and releasing the progeny to the stream in stages from egg to early-smolt. In most cases, fish would be held only for a short time as adults before spawning and then, possibly, for a short time as juveniles before release. Early release (egg, fry, or fingerling) is preferred because it increases opportunities for natural selection to occur in the stream and decreases the opportunity for domestication selection to occur in the hatchery. Smolt releases should only be employed if the benefit of improved survival (e.g., to offset winter mortality) outweighs the risk of extended hatchery rearing. Recovery supplementation programs would differ from other supplementation programs by the high level of genetic management and monitoring involved, and the goal of producing fish that are as genetically, morphologically, behaviorally, and ecologically similar to naturally produced fish as possible.

Captive broodstock programs would involve capturing fish at one of several points in the life cycle, raising them or their progeny to maturity as broodstock, and spawning them as they mature. Captive broodstock can be implemented purely as insurance against cohort failure or the loss of the entire run, in which fish would not be released unless special conditions were met. Alternatively, captive broodstock could be a component of a recovery supplementation program, in which fish would be regularly released. Cryopreservation of gametes (sperm) provides some needed spawning flexibility, and may allow rebuilding missing year classes. It should be a part of either type of program. Some programs may choose to use all three elements to meet their goals.

Guidelines for operation of a recovery hatchery are shown in Table H-2. The guidelines address four issues: source populations for broodstock, spawning, fish rearing and release pro-

tocols. These are general guidelines that can be developed in greater detail based on the specific needs of each project.

Population genetics data (e.g., amount of within-population diversity, patterns of between-population diversity, and relationships among ancestral lineages) and other information on life history are essential to determine which populations are most similar to one another for broodstock selection. If stock transfers have occurred or if hatchery influence is suspected, then these analyses are even more important. The short-term goals of recovery hatcheries are to stabilize or increase population size (hatchery-origin + natural origin) while at the same time preserving within-population genetic diversity, between-population diversity patterns, and adaptive variation, with the long-term goal of establishing self-sustaining viable populations. Knowledge of population genetic structure is critical to establishment of an effective program.

ESSENTIAL PROGRAM ELEMENTS AND OPPORTUNITIES FOR DEVELOPMENT OF A HATCHERY RESEARCH PROGRAM

Although each program will be somewhat different due to differing needs and means to achieve them, we identify a suite of essential program elements that every hatchery recovery program should contain. In this section we also explore the need for dissemination of research.

Every recovery hatchery program should have the following elements.

1. The program should have a written plan that identifies well-defined program goals and management actions to achieve them. The program should be justified by an evaluation of the relative benefits and risks of alternative hatchery practices, alternative non-hatchery means to achieving the program goals, and a no action alternative. This evaluation should be included in the plan. The plan should also include research goals, a monitoring and evaluation plan, contingency and emergency plans, and a decommission plan.
2. A steering committee should be in place even before the hatchery begins operation to advise and provide technical expertise (see Policies). The steering committee should meet quarterly to discuss adaptive management of the program.
3. Genetic monitoring and broodstock management are the cornerstones of a successful recovery hatchery and should be included in the operations plan.
4. Recovery hatchery programs should have appropriate levels of redundancy and safeguards to secure broodstock and production (e.g., redundant water supplies and electricity, secure areas away from the general public for holding fish).
5. Recovery hatchery programs are unproven for recovery purposes. Therefore, any information or experience gained is of tremendous value to adaptive management of them. Sharing information and regular reporting, both written reports and presentations, are critical to effective management of these programs, and will be required.
6. Thresholds should be identified as triggers for adaptive management.
7. Recovery hatchery programs should develop written plans that clearly document the program. This report should be annual while the program is in place, with a final report that evaluates the entire program when it is completed.
8. A monitoring component should be outlined that assesses the effectiveness of the recovery hatchery program and its ability to aid in the recovery of native, natural-spawning coho salmon.

9. Research components could be identified that address questions relevant to improving conservation/hatchery technology, hatchery-natural interactions, and use of hatchery fish in species recovery.
10. Provisions should be in place for troubleshooting and problem solving. This is an important part of the work of the steering committee. Adaptive management should be an integral part of the program.
11. Very early in the development of the project, each project should write an emergency interruption plan (if one does not already exist) in case of emergency disruption of the project (e.g., due to loss of water availability or quality, catastrophes and accidents, staff or budget cuts, disease outbreaks). The plan should detail what will happen to broodstock, production, staff, and how to maintain the project off site if necessary. All existing California hatcheries currently have such plans already.
12. Multiple facilities should be considered for housing broodstock and production to spread the risk of catastrophes. This is especially important for listed species but is important for any valuable broodstock.
13. Program monitoring and reporting is an essential feature of the program (see the following section).

PROGRAM MONITORING

Each program should have a schedule for interim evaluation of program success in relation to program goals and to document program activities. Because these programs rely on adaptive management and are relatively "new" and experimental, the timely documentation of results is crucial to program success. Written annual reports will be required that document both captive breeding statistics (e.g., number spawned, spawning matrix, percent eye-up, life-stage specific mortality, problems that arose and their solutions, number of fish released, size of release, growth rate, genetic analysis of broodstock and production), and field related statistics (e.g., number of returning adults, effect of releases on effective population size of the combined hatchery and natural population, carrying capacity and habitat availability as it relates to release size, ecological interactions among hatchery and natural fish, outmigration timing of hatchery and natural fish, contribution of hatchery stock to natural spawning, ocean impacts (e.g., effects of Pacific Decadal Oscillation, El Niño/La Niña events, changes in upwelling indexes), fishery impacts on hatchery stocks). A periodic reevaluation of risks should also be included in progress reports. The Department should develop a standard data reporting format that would simplify and streamline the reporting process for recovery hatcheries.

In order to effectively monitor the hatchery population, each fish released should receive a unique tag and an external mark. Typically this unique tag will be a coded wire tag, but other tagging methods (e.g., PIT tags) are possible depending on funding, hatchery logistics, new techniques, and need. Projects should plan on 100 percent tagging of releases and subsequent monitoring to determine their fate.

Each program should also make provisions for a comprehensive final report that documents the program's history and activities and interprets the results of the program over its life span. This report should include recommendations on ways to improve recovery hatchery programs in the future.

Programs should clearly delineate procedures for disseminating research results generated by the facility. Permits should contain language that connects resource agencies with regular

reporting of research results pertaining to the project. Reporting must be regular, informative, and in a format usable by the resource agencies for adaptive management of the program.

PROGRAM DURATION, CLOSEOUT GUIDELINES, CONTINGENCY AND EMERGENCY CLOSEOUT PLANS, AND DISPOSITION OF UNUSED BROODSTOCK

Recovery hatchery programs are envisioned to be short term projects with lifespans on the order of 1-4 coho salmon generations (3-12 years). A closed recovery hatchery would represent a successful effort that was able to substantially contribute to recovery of the species. Because of this built in short lifespan, it is essential that each program develop early in its life a close-out plan. The close-out plan should at minimum contain the following.

1. The expected life of the program and conditions under which the facility should initiate close-out. These should be tied to reaching recovery goals specific to the program as well as overall recovery goals. Performance standards should be evaluated for years 1-3 and if met, 4-6, 7-9, etc. Failure to meet performance standards in two generations should, in most cases, trigger initiation of close-out procedures.
2. Provisions for closing the facility, including a possible end use.
3. Provisions for disposition of unused broodstock and any other fish on-site at the time of close-out.
4. Provisions for staff transition.
5. Production and dissemination of a final documentation report.

A second plan should be produced that describes how the facility will deal with an emergency close-out that might occur with little or no warning due to accident or catastrophe, or a funding shortfall. These plans should contain the provisions above, but should take into account that the implementation time may be very short.

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ATTACHMENT 1: GLOSSARY

Artificial propagation: Human assistance in the reproduction of an organism. In Pacific salmon, artificial propagation may include spawning and rearing in hatcheries, stock transfers, creation of spawning habitat, egg bank programs, captive broodstock programs, and cryopreservation of gametes.

Captive broodstock program: A form of artificial propagation involving the collection of individuals or gametes from a natural population and rearing of these individuals to maturity in captivity.

Carrying capacity: The maximum equilibrium number of individuals of a particular species that can be supported indefinitely in a given environment. *Abbr.: K.*

CESA: California Endangered Species Act.

Cohort failure: Extinction of a cohort (year-class) of fish due to either a lack of spawning in that year or to failure of any offspring of a spawning event to survive. Also called brood-year extinction.

Cryopreservation: Preservation of living gametes at very low temperature. Typically, freezing sperm in liquid nitrogen for later use in spawning.

Domestication selection: Natural selection operating on a population during artificial propagation that encourages adaptation to the hatchery environment at the expense of adaptation to the natural environment.

Effective population size: Used in management of genetic resources to express information about expected rates of random genetic change due to inbreeding and/or genetic drift. The size of a hypothetical ideal population with the same amount of random genetic change as the actual population experiences. Typically the effective population size is lower than the census population size. *Abbr.:* N_e.

ESA: Federal Endangered Species Act.

Evolutionarily Significant Unit (ESU): A population or group of populations that is considered distinct, and hence a species, for purposes of the Endangered Species Act. An ESU must be reproductively isolated from other populations of the same species and must represent an important component in the evolutionary legacy of the species.

Extinction: In evolutionary biology, the failure of groups of organisms of varying size and inclusiveness (e.g., local geographic or temporally-defined groups to species) to have surviving descendants.

Extinction risk: In this document, the probability that a given population will become extinct within 100 years. Low probability of extinction is arbitrarily defined for this purpose as 5% over 100 years.

Hatchery-origin fish: Also, "hatchery fish." Fish that have spent some portion of their lives, usually their early lives, in a hatchery. (See natural-origin fish.)

Metapopulation: A set of largely isolated subpopulations connected by some degree of migration among them.

Monitoring: Scientific inquiry focused on evaluation of a program in relation to its goals (see Research).

Natural-origin fish: Also, "natural fish." Fish that are offspring of parents that spawned in the wild.

Natural-origin fish spend their entire lives in the natural environment. (See hatchery-origin fish.)

Population: A group of individuals of the same species that live in the same place at the same time and exhibit some level of reproductive isolation from other such groups. In some contexts, a randomly mating group of individuals that is reproductively isolated from other groups. A population may consist of a single isolated run or more than one connected run. Synonymous with "stock" in this document.

Population size: In this document, the number of, usually adult, fish in the population. Also known as census size of the population. Abundance.

Recovery: The re-establishment or rehabilitation of a threatened or endangered species to a self-sustaining level in its natural ecosystem.

Recovery supplementation: Short-term artificial propagation designed to reduce the risk of extinction of a small or chaotically fluctuating recovering population in its natural habitat by temporarily increasing population size using recovery hatchery fish, while maintaining available genetic diversity and avoiding genetic change in the natural and hatchery populations.

Research: Scientific inquiry focused on answering original questions. May consist of experiments or original descriptions of structures, relationships, and processes (See Monitoring).

Run: The spawning adults of a given species that return to a stream during a given season.

Self-sustaining population: A population that perpetuates itself without human intervention, without chronic decline, and in its natural ecosystem, at sufficient levels that listing under CESA is not warranted.

Source-sink relationship: Metapopulation structure in which subpopulations in the source areas have vastly different productivities than those is the sink areas, and characterized by one-way movement of migrants from the source area to the sink area.

Stock: See "population."

Stock transfer: Human-caused transfer of fish from one location to another, typically in the context of out-of-basin or out-of-ESU transfers.

ATTACHMENT 2: PARTICIPANTS ON THE HATCHERY WORKING GROUP OF THE CALIFORNIA COHO SALMON RECOVERY TEAM AND DEPARTMENT REVIEWERS

HATCHERY WORKING GROUP:

Michael Lacy, DFG (Chair)
Jean Baldrige, Entrix
George Kautsky, Hoopa Tribal Fisheries
Greg Bryant, NOAA Fisheries
Daniel Logan, NOAA Fisheries
Shirley Witalis, NOAA Fisheries
Ruth Sundermeyer, Entrix
Paul Siri, Private Consultant to Sonoma County Water Agency

DFG REVIEWERS:

Chuck Knutsen
Royce Gunter
Brett Wilson
Bob Coey
Larry Preston
Gary Stacey
Bob McAllister
Kevan Urquhart
Jennifer Nelson
Gail Newton
Dennis McEwan

ATTACHMENT 3: SECTIONS OF THE 2003 FISH AND GAME CODE RELEVANT TO THE ESTABLISHMENT AND OPERATION OF RECOVERY HATCHERIES FOR ANADROMOUS SALMONIDS

FISH AND GAME CODE §§1120-1126

1120. The commission shall establish fish hatcheries for stocking the waters of this State with fish. The department shall maintain and operate such hatcheries.

1121. In any lease entered into whereby the State leases from any county, city, irrigation district, or other public agency in this State, real property for the purpose of establishing or maintaining a fish hatchery, the State may agree to indemnify and hold harmless the lessor by reason of the uses authorized by such lease. Insurance may be purchased by the Department of General Services to protect the State against loss or expense arising out of such an agreement.

1122. Any claim for damages arising against the State under Section 1121 shall be presented to the State Board of Control in accordance with Section 905.2 of the Government Code, and if not covered by insurance as herein provided shall be payable only out of funds appropriated by the Legislature for such purposes. If the State elects to insure its liability under Section 1121, the State Board of Control may automatically deny any such claim.

1123. The department may purchase and import spawn or ova of fish suitable for food, and stock with such spawn or ova the waters of this State.

1123.5. Notwithstanding Section 1120 or any other provision of law, all funds allocated for fish purchases for the department's urban fishing program shall be used to purchase all fish and aquatic organisms by contract, pursuant to the requirements of the Public Contract Code, from private registered aquaculture facilities within the State unless the department determines one of the following conditions exists:

(a) After reasonable notice, the private facilities are unable to provide the specified fish or aquatic organism.

(b) The fish or aquatic organism is infected or diseased.

1124. It is unlawful to take any fish in any pond or reservoir belonging to or controlled by the department and used for propagating, protecting, or conserving fish.

1125. The Secretary of the Interior of the United States and his duly authorized agents may conduct fish cultural operations and scientific investigations in the waters of this State in such a manner and at such times as may be jointly considered necessary and proper by the secretary and his agents, and the commission.

1126. Notwithstanding any other provision of law, department personnel may construct or repair bird exclosures at State owned or operated fish hatcheries. These activities shall not be subject to review by the Public Works Board. Nothing in this section exempts the department from complying with any provision of law governing services performed under contract by noncivil service employees.

FISH AND GAME CODE §1150

1150. The boards of supervisors of the several counties may establish and maintain fish hatcheries, and may purchase the spawn or ova of fish.

FISH AND GAME CODE §§1170-1175

1170. The commission may issue a permit, subject to such restrictions and regulations as the commission deems desirable, to a nonprofit organization to construct and operate an anadromous fish hatchery.

1171. The commission shall not issue a permit unless it determines the nonprofit organization has the financial capability to successfully construct and operate the hatchery and will diligently and properly conduct the operation authorized under the permit.

1172. No permit will be issued which may tend to deplete the natural runs of anadromous fish, result in waste or deterioration of fish, or when the proposed operation is located on a stream or river below a State or Federal fish hatchery or egg-taking station.

1173. All fish handled under authority of this article during the time they are in the hatchery or in the wild are the property of the State and when in the wild may be taken under the authority of a sport or commercial fishing license as otherwise authorized for wild fish.

1174. Any permit granted by the commission pursuant to this article shall contain all of the following conditions:

(a) If after a hearing the commission finds that the operation described in the permit and conducted pursuant to this article is not in the best public interest, the commission may alter the conditions of the permit to mitigate the adverse effects, or may cause an orderly termination of the operation under the permit. An orderly termination shall not exceed a three-year period and shall culminate in the revocation of the permit in its entirety.

(b) If the commission finds that the operation has caused deterioration of the natural run of anadromous fish in the waters covered by the permit, it may require the permittee to return the fishery to the same condition as was prior to issuance of the permit. If the permittee fails to take appropriate action, the commission may direct the department to take the action, and the permittee shall bear any cost incurred by the department.

(c) Prior to release into State waters and at any other time deemed necessary by the department, the fish may be examined by the department to determine that they are not diseased or infected with any disease which, in the opinion of the department, may be detrimental to the State fishery resources.

1175. The State shall assume no responsibility for the operation of a hatchery pursuant to this article and shall not be in any manner liable for its operation.

FISH AND GAME CODE §§1200-1206

1200. The department is authorized to enter into agreements with counties, nonprofit groups, private persons, individually or in combination, for the management and operation of rearing facilities for salmon and steelhead. All such agreements shall be in accordance with the policies of the commission and the criteria of the department which govern the operation under such agreements. The purpose for operating such facilities shall be to provide additional fishing resources and to augment natural runs.

1201. An applicant who wishes to enter into an agreement to operate a rearing facility shall demonstrate, to the satisfaction of the department prior to executing such agreement, such applicant's financial ability to properly operate the rearing facility. The department shall develop and specify the means for an applicant to make such a demonstration.

1202. All fish handled or released under authority of this article are the property of the State and may be taken only after their release into the wild and under the authority of a sport or commercial fishing license.

1203. The release of fish reared in facilities pursuant to this article shall be made in accordance with the policy of the commission.

1204. The department shall fund the agreements provided for in Section 1200 only on a matching basis with the persons or entities who enter into such agreements. Funds appropriated for the purposes of this article shall not be used to purchase equipment or for construction. The department shall be reimbursed from funds appropriated for the purposes of this article for administrative costs, legal costs, and supervisorial costs relating to the execution and supervision of such agreements by the department.

1205. The department shall, subject to the limitations of appropriate egg sources and funding, make available fish of appropriate size and species to persons or entities who enter into agreements pursuant to this article.

1206. Salmon and steelhead raised pursuant to this article shall be released in streams, rivers, or waters north of Point Conception and upon release shall have unimpeded access to the sea.

FISH AND GAME CODE §6100

6100. Notwithstanding any provision of Article 3 (commencing with Section 5980) and Article 4 (commencing with Section 6020), on or after the effective date of this article, any new diversion of water from any stream having populations of salmon and steelhead which is determined by the department to be deleterious to salmon and steelhead shall be screened by the owner. The construction, operation, or maintenance costs of any screen required pursuant to this article shall be borne by the owner of the diversion.

The department within 30 days of receipt of a notice of such diversion, or within the time determined by mutual written agreement, shall submit to the owner its proposals as to measures necessary to protect the salmon and steelhead. The department shall notify the owner that it shall make onsite investigation and shall make any other investigation before it shall propose any measure necessary to protect fishlife.

The department, or any agency of the State, shall provide the owner of the diversion any available information which is required by such owner in order to comply with the provisions of this article. The diversion shall not commence until the department has

determined that measures necessary to protect fishlife have been incorporated into the plans and construction of such diversion.

FISH AND GAME CODE §§6900-6903.5

6900. This chapter shall be known and may be cited as the Salmon, Steelhead Trout, and Anadromous Fisheries Program Act.

6901. The Legislature, for purposes of this chapter, finds as follows:

(a) According to the department, the natural production of salmon and steelhead trout in California has declined to approximately 1,000,000 adult chinook or king salmon, 100,000 coho or silver salmon, and 150,000 steelhead trout.

(b) The naturally spawning salmon and steelhead trout resources of the State have declined dramatically within the past four decades, primarily as a result of lost stream habitat on many streams in the State.

(c) Much of the loss of salmon and steelhead trout and anadromous fish in the State has occurred in the central valley.

(d) Protection of, and an increase in, the naturally spawning salmon and steelhead trout resources of the State would provide a valuable public resource to the residents, a large statewide economic benefit, and would, in addition, provide employment opportunities not otherwise available to the citizens of this State, particularly in rural areas of present underemployment.

e) Proper salmon and steelhead trout resource management requires maintaining adequate levels of natural, as compared to hatchery, spawning and rearing.

(f) Reliance upon hatchery production of salmon and steelhead trout in California is at or near the maximum percentage that it should occupy in the mix of natural and artificial hatchery production in the State. Hatchery production may be an appropriate means of protecting and increasing salmon and steelhead in specific situations; however, when both are feasible alternatives, preference shall be given to natural production.

(g) The protection of, and increase in, the naturally spawning salmon and steelhead trout of the State must be accomplished primarily through the improvement of stream habitat.

(h) Funds provided by the Legislature since 1978 to further the protection and increase of the fisheries of the State have been administered by the Department of Fish and Game in a successful program of contracts with local government and nonprofit agencies and private groups in ways that have attracted substantial citizen effort.

(i) The department's contract program has demonstrated that California has a large and enthusiastic corps of citizens that are eager to further the restoration of the stream and fishery resources of this State and that are willing to provide significant amounts of time and labor to that purpose.

(j) There is need for a comprehensive salmon, steelhead trout, and anadromous fisheries plan, program, and State government organization to guide the State's efforts to protect and increase the naturally spawning salmon, steelhead trout, and anadromous fishery resources of the State.

6902. The Legislature, for purposes of this chapter, declares as follows:

(a) It is the policy of the State to significantly increase the natural production of salmon and steelhead trout by the end of this century. The department shall develop a plan and a program that strives to double the current natural production of salmon and steelhead trout resources.

(b) It is the policy of the State to recognize and encourage the participation of the public in privately and publicly funded mitigation, restoration, and enhancement programs in order to protect and increase naturally spawning salmon and steelhead trout resources.

(c) It is the policy of the State that existing natural salmon and steelhead trout habitat shall not be diminished further without offsetting the impacts of the lost habitat.

6903. It is the policy of the State and the department to encourage nonprofit salmon release and return operations subject to this code operated by, or on behalf of, licensed commercial salmon fishermen for the purpose of enhancing California's salmon populations and increasing the salmon harvest by commercial and recreational fishermen. The department shall, to the extent that funds and personnel are available, cooperate with fishing organizations in the siting and establishment of those operations to ensure the protection of natural spawning stocks of native salmon. The organizations conducting the operations may receive salmon eggs and juvenile salmon for the purposes of the operation, and, where appropriate, shall have priority to receive salmon eggs and juvenile salmon for those purposes after the needs of habitat mitigation efforts, and State hatcheries are met.

6903.5. The department shall encourage other nonprofit hatcheries and nonprofit artificial propagation operations, operated by, or on behalf of, licensed fishermen, for the purpose of rebuilding or enhancing marine fish populations, including, but not limited to, those for Dungeness crab, sea urchin, and California halibut, consistent with the protection of these species in the wild, in order to provide sustainable marine fish populations for harvest by commercial and recreational fishermen. The department shall, to the extent funds and personnel are available, cooperate with these nonprofit hatcheries and nonprofit artificial propagation operations in determining the feasibility, siting, and establishment of those activities and sharing technical information to ensure the protection of the marine environment.

6920. (a) The department shall, with the advice of the Advisory Committee on Salmon and Steelhead Trout and the Commercial Salmon Trollers Advisory Committee, prepare and maintain a detailed and comprehensive program for the protection and increase of salmon, steelhead trout, and anadromous fisheries.

(b) The department shall consult with every public agency whose policies or decisions may affect the goals of this program to determine if there are feasible means for those public agencies to help the department achieve the goals of this program.

6921. The program shall identify the measures the department will carry out to achieve the policies set forth in Section 6902.

6922. The program shall include, but is not limited to, all of the following elements:

(a) Identification of streams where the natural production of salmon and steelhead trout can be increased primarily through the improvement of stream and streambank conditions without effect on land ownership, land use practices, or changes in streamflow operations.

(b) Identification of streams where the natural production of salmon and steelhead trout can be increased only through the improvement of land use practices or changes in streamflow operations.

(c) Identification of streams where the protection of, and increase in, salmon and steelhead trout resources require, as a result of significant prior loss of stream habitat, the construction of artificial propagation facilities.

(d) A program element for evaluating the effectiveness of the program.

(e) Recommendations for an organizational structure, staffing, budgeting, long-term sources of funding, changes in State statutes and regulations and Federal and local government policy and such other administrative and legislative actions as the department finds to be necessary to accomplish the purposes of this chapter.

(f) Identification of measures to protect and increase the production of other anadromous fisheries consistent with policies set forth in Section 6902.

(g) Identification of alternatives to, or mitigation of, manmade factors which cause the loss of juvenile and adult fish in California's stream system.

6923. Measures which are the responsibility of other agencies or persons, such as the repair or replacement of dysfunctional fish screens, are not eligible for funding under the program.

6924. The department shall determine the initial elements of the program and transmit a report describing those elements to the Legislature and the Advisory Committee on Salmon and Steelhead Trout within six months of the effective date of this chapter.

ATTACHMENT 4: CALIFORNIA FISH AND GAME COMMISSION POLICIES RELEVANT TO THE ESTABLISHMENT AND OPERATION OF RECOVERY HATCHERIES

CALIFORNIA FISH AND GAME COMMISSION POLICY ON COOPERATIVELY OPERATED REARING PROGRAMS FOR SALMON AND STEELHEAD

It is the policy of the Fish and Game Commission that:

I. The State's salmon and steelhead resources may be used to support cooperative rearing programs. Rearing programs may be of two types: (1) those that grow fish for use in accelerating the restoration/rehabilitation of depleted wild populations in underseeded habitat and (2) those that are dedicated solely to growing fish for harvest. The following constraints apply to both types:

   A. Only those fish surplus to the needs of the Department's programs shall be utilized for such programs and allocation shall be based on past performance and the Department's evaluation of the potential of proposed new programs.

   B. The suitability and acceptance or rejection of proposed programs shall be determined by the Department, after reviewing a written proposal. A written project and management plan providing for evaluation and covering a period of five years must be evaluated and approved by the Department. Prior to reauthorization the Department must determine that the project is in compliance with the approved plan and continuance of the program is in the best interest of the State's fishery resources.

   C. Routine care and food costs shall be the financial responsibility of the sponsoring entity. The Department shall provide technical advice and special assistance as appropriate.

   D. Fish raised in these programs shall not be stocked in, or broodstock captured from, waters where the Department has determined that adverse effects to native fish populations or other aquatic species may result.

II. The bulk of the State's salmon and steelhead resources shall be produced naturally. The State's goals of maintaining and increasing natural production take precedence over the goals of cooperatively operated rearing programs.

(Amended 6/18/93)

CALIFORNIA FISH AND GAME COMMISSION POLICY ON SALMON

It is the policy of the Fish and Game Commission that:

I. Salmon shall be managed to protect, restore and maintain the populations and genetic integrity of all identifiable stocks. Naturally spawned salmon shall provide the foundation for the Department's management program.

II. Salmon streams shall be inventoried for quantity and quality of habitat, including instream flow requirements. Restoration plans shall identify habitats for restoration and acquisition and opportunities to protect or guarantee future instream flows. Commercial Salmon Trollers Stamp and other funding shall be directed to implement the plans.

III. Existing salmon habitat shall not be diminished further without offsetting the impacts of the lost habitat. All available steps shall be taken to prevent loss of habitat, and the Department shall oppose any development or project which will result in irreplaceable loss of fish. Artificial production shall not be considered as appropriate mitigation for loss of wild fish or their habitat.

IV. Salmon shall be rescued only when they will be returned to the stream system of origin. Rescue of juvenile salmon shall be limited to circumstances where fish can be held until habitat conditions improve, or where immediate release can be made in understocked areas of their natal stream system.

V. In coastal streams without Department hatcheries, artificial rearing shall be limited to areas where the Department determines it would be beneficial to supplement natural production to re-establish or enhance the depleted wild population. In the Sacramento, American, Feather, San Joaquin, Klamath, and Trinity river systems, hatchery production shall be used to meet established mitigation goals. At the discretion of the Department excess eggs and fish from State, Federal, or cooperative hatcheries may be used to provide additional fish for the commercial and sport fisheries.

VI. Resident fish will not be planted or resident fisheries developed in drainages of salmon waters, where, in the opinion of the Department, such planting or development will interfere with salmon populations. Exceptions to this policy may be authorized by the Commission (a) where the stream is no longer adaptable to anadromous runs, or (b) during the mid-summer period in those individual streams considered on a water-by-water basis where there is a high demand for angling recreation and such planting or development has been determined by the Department not to be detrimental to salmon.

(Amended 6/18/93)

CALIFORNIA FISH AND GAME COMMISSION POLICY ON STEELHEAD RAINBOW TROUT

It is the policy of the Fish and Game Commission that:

I. Steelhead rainbow trout shall be managed to protect and maintain the populations and genetic integrity of all identifiable stocks. Naturally spawned steelhead shall provide the foundation of the Department's management program.

II. Steelhead shall be rescued only when they will be returned to the stream system of origin. Rescue of juvenile steelhead shall be limited to circumstances where fish can be held until habitat conditions improve, or where immediate release can be made in understocked areas of their natal stream system.

III. Restoration and acquisition plans shall be developed and implemented to safeguard such critical habitats as estuaries, coastal lagoons, and spawning and rearing areas, and to protect or guarantee future instream flows. All steelhead streams shall be inventoried for quantity and quality of habitat, including stream flow conditions. Steelhead Restoration Card and other funding shall be directed to implement the plans.

IV. Existing steelhead trout habitat shall not be diminished further without offsetting mitigation of equal or greater long-term habitat benefits. All available steps shall be taken to prevent loss of habitat, and the Department shall oppose

any development or project which will result in irreplaceable losses. Artificial production shall not be considered appropriate mitigation for loss of wild fish or their habitat.

V. Sport fishing for sea-run steelhead shall be encouraged where the Department has determined that harvest will not harm existing wild populations. Harvest of juveniles shall only be permitted where such harvest does not impair adequate returns of adults for sport fishing and spawning. Special restrictions on the harvest of wild juvenile steelhead may be necessary when a fishery includes both wild and hatchery stocks.

VI. Resident fish will not be planted or resident fisheries developed in drainages of steelhead waters, where, in the opinion of the Department, such planting or development will interfere with steelhead populations.

VII. Exceptions to this policy may be made by the Commission (a) where the stream is no longer adaptable to anadromous runs, or (b) during the midsummer period in those individual streams considered on a water-by-water basis where there is a high demand for angling recreation and such planting or development has been determined by the Department not to be detrimental to steelhead.

The following waters are excepted:

Nacimiento River San Luis Obispo County
North Fork Battle Creek Shasta County, (upstream from Manton)
Cow Creek Shasta County, (upstream from Fern Road and Ingot)
Antelope Creek Tehama County, (upstream from Ponderosa Way)
Deer Creek Tehama County, (upstream from upper Deer Creek Falls)
American River Sacramento County, (only in Arden Pond)

(Amended 6/18/93)

TABLE 4. Alternative developmental stages for fish used to initiate populations in restored streams.

Stage	Advantages	Disadvantages	Comments
Adult	Naturalization begins immediately and occurs over the first cohort's entire life. Low cost.	Spawning success may be low owing to egress or suboptimal spawning distribution (because spawners did not imprint within the "new" stream as juveniles) or stress from handling and transporting (Shreck et al. 2001), and – for hatchery adults – ineffective mating and spawning behavior (e.g., Leider et al. 1990; Fleming and Gross 1994).	Reproductive success and juvenile survival are likely to be greater with translocated adults from nearby, environmentally similar streams than with hatchery adults. In some situations low spawning success, in conjunction with subsequent low survival of progeny due to poor genetic adaptedness to the new stream, may result in few if any progeny surviving to reproduce, and low effective population size.
Embryo or fry (incubated in a hatchery, steamside incubator or artificial redd)	Naturalization occurs in the first cohort over nearly the entire period of freshwater rearing. Avoids possible low spawning success from releases of (F_0) adults. Low cost.	Often requires manipulation of water temperatures at a hatchery to mimic those in various parts of the watershed so as to achieve appropriate timing of development.	The increased survival from conception or incubation in a hatchery should result in many more fish surviving to maturity than from natural spawning of translocated adults. Despite some failed fry releases, often due to inappropriate time or condition at release into streams already seeded with wild fish or into streams with poor habitat (e.g., McGie 1980; Lestelle et al. 1993), our experience and that of others (e.g., Close and Anderson 1992) suggest that fry releases can be very effective in establishing populations.
Juvenile, after a period of feeding in a hatchery	High survival while in the hatchery which presumably leads to increased production of (F_1) adults.	Early rearing in the hatchery (domestication) probably retards naturalization. Intermediate cost due to extended hatchery rearing and transport of large fish at outplanting. Once natural reproduction occurs, releases of "fed-fry" can result in severe competition and suppression of juveniles from natural spawning (Nickelson et al. 1986).	The net results of domestication (Reisenbichler and Rubin 1999; Waples 1999) during early freshwater rearing and then naturalization during subsequent freshwater rearing is unknown; however, the naturalization of such a cohort should be substantially less than that of a cohort released as fry. Fed fry must not be larger than F_1 or later juveniles from natural spawning; otherwise, naturalization will be delayed as the latter are displaced or suppressed by the former.
Smolt, reared in a hatchery	High survival to returning (F_1) adult.	Cohort experiences domestication; naturalization is delayed until the F_1 generation, which also suffers from poor reproductive success of returning F_0 fish as discussed above for adult releases. High cost due to "full-term" hatchery rearing and transport of large fish at outplanting.	Probably produces the greatest number of adults spawning in the F_1 generation, but delays naturalization and probably restoration because of genetic bottlenecks (when many matings of adult F_0 fish are unsuccessful) and domestication. Some stakeholders nevertheless favor this strategy because it is most consistent with conventional hatchery protocol, has been highly successful in augmenting harvest, and gives the illusion of rapid restoration when large numbers of (hatchery) adults spawn naturally.